

BFU590G

NPN wideband silicon RF transistor

Rev. 1 — 28 April 2014

Product data sheet

1. Product profile

1.1 General description

NPN silicon microwave transistor for high speed, medium power applications in a plastic, 4-pin SOT223 package.

The BFU590G is part of the BFU5 family of transistors, suitable for small signal to medium power applications up to 2 GHz.

1.2 Features and benefits

- Medium power, high linearity, high breakdown voltage RF transistor
- AEC-Q101 qualified
- Maximum stable gain 13 dB at 900 MHz
- $P_{L(1dB)}$ 21.5 dBm at 900 MHz
- 8.5 GHz f_T silicon technology

1.3 Applications

- Automotive applications
- Broadband amplifiers
- Medium power amplifiers (500 mW at a frequency of 433 MHz or 866 MHz)
- Large signal amplifiers for ISM applications

1.4 Quick reference data

Table 1. Quick reference data

$T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|---------------------------|---|-----|-----|------|------|
| V_{CB} | collector-base voltage | open emitter | - | - | 24 | V |
| V_{CE} | collector-emitter voltage | open base | - | - | 12 | V |
| | | shorted base | - | - | 24 | V |
| V_{EB} | emitter-base voltage | open collector | - | - | 2 | V |
| I_C | collector current | | - | 80 | 200 | mA |
| P_{tot} | total power dissipation | $T_{sp} \leq 90\text{ }^{\circ}\text{C}$ [1] | - | - | 2000 | mW |
| h_{FE} | DC current gain | $I_C = 80\text{ mA}; V_{CE} = 8\text{ V}$ | 60 | 95 | 130 | |
| C_c | collector capacitance | $V_{CB} = 8\text{ V}; f = 1\text{ MHz}$ | - | 1.9 | - | pF |
| f_T | transition frequency | $I_C = 80\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}$ | - | 8.5 | - | GHz |



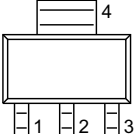
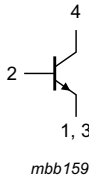
Table 1. Quick reference data ...continued
 $T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|---------------------------------------|--|-----|------|-----|------|
| $G_{p(max)}$ | maximum power gain | $I_C = 80\text{ mA}$; $V_{CE} = 8\text{ V}$; $f = 900\text{ MHz}$ [2] | - | 13 | - | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | $I_C = 80\text{ mA}$; $V_{CE} = 8\text{ V}$; $Z_S = Z_L = 50\text{ }\Omega$; $f = 900\text{ MHz}$ | - | 21.5 | - | dBm |

- [1] T_{sp} is the temperature at the solder point of the collector lead.
 [2] If $K > 1$ then $G_{p(max)}$ is the maximum power gain. If $K < 1$ then $G_{p(max)} = MSG$.

2. Pinning information

Table 2. Discrete pinning

| Pin | Description | Simplified outline | Graphic symbol |
|-----|-------------|---|--|
| 1 | emitter |  |  |
| 2 | base | | |
| 3 | emitter | | |
| 4 | collector | | |

3. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|-------------|---------|--|---------|
| | Name | Description | Version |
| BFU590G | - | plastic surface-mounted package with increased heatsink; 4 leads | SOT223 |
| OM7966 | - | Customer evaluation kit for BFU580G and BFU590G [1] | - |

- [1] The customer evaluation kit contains the following:
- Unpopulated RF amplifier Printed-Circuit Board (PCB)
 - Unpopulated RF amplifier Printed-Circuit Board (PCB) with emitter degeneration
 - Four SMA connectors for fitting unpopulated Printed-Circuit Board (PCB)
 - BFU580G and BFU590G samples
 - USB stick with data sheets, application notes, models, S-parameter and noise files

4. Marking

Table 4. Marking

| Type number | Marking |
|-------------|---------|
| BFU590G | BFU590 |

5. Design support

Table 5. Available design support

Download from the BFU590G product information page on <http://www.nxp.com>.

| Support item | Available | Remarks |
|---|-----------|---|
| Device models for Agilent EEsof EDA ADS | yes | Based on Mextram device model. |
| SPICE model | yes | Based on Gummel-Poon device model. |
| S-parameters | yes | |
| Customer evaluation kit | yes | See Section 3 and Section 10 . |
| Solder pattern | yes | |
| Application notes | yes | See Section 10.1 and Section 10.2 . |

6. Limiting values

Table 6. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|---------------------------------|---|-----|------|------|
| V_{CB} | collector-base voltage | open emitter | - | 30 | V |
| V_{CE} | collector-emitter voltage | open base | - | 16 | V |
| | | shorted base | - | 30 | V |
| V_{EB} | emitter-base voltage | open collector | - | 3 | V |
| I_C | collector current | | - | 300 | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| V_{ESD} | electrostatic discharge voltage | Human Body Model (HBM) According to JEDEC standard 22-A114E | - | ±250 | V |
| | | Charged Device Model (CDM) According to JEDEC standard 22-C101B | - | ±2 | kV |

7. Recommended operating conditions

Table 7. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|---------------------------|---|-----|-----|------|------|
| V_{CB} | collector-base voltage | open emitter | - | - | 24 | V |
| V_{CE} | collector-emitter voltage | open base | - | - | 12 | V |
| | | shorted base | - | - | 24 | V |
| V_{EB} | emitter-base voltage | open collector | - | - | 2 | V |
| I_C | collector current | | - | - | 200 | mA |
| P_i | input power | $Z_S = 50 \Omega$ | - | - | 20 | dBm |
| T_j | junction temperature | | -40 | - | +150 | °C |
| P_{tot} | total power dissipation | $T_{sp} \leq 90 \text{ °C}$ [1] | - | - | 2000 | mW |

[1] T_{sp} is the temperature at the solder point of the collector lead.

8. Thermal characteristics

Table 8. Thermal characteristics

| Symbol | Parameter | Conditions | Typ | Unit |
|----------------|--|------------|--------|------|
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point | | [1] 30 | K/W |

[1] T_{sp} is the temperature at the solder point of the collector lead.

T_{sp} has the following relation to the ambient temperature T_{amb} :

$$T_{sp} = T_{amb} + P \times R_{th(sp-a)}$$

With P being the power dissipation and $R_{th(sp-a)}$ being the thermal resistance between the solder point and ambient. $R_{th(sp-a)}$ is determined by the heat transfer properties in the application.

The heat transfer properties are set by the application board materials, the board layout and the environment e.g. housing.

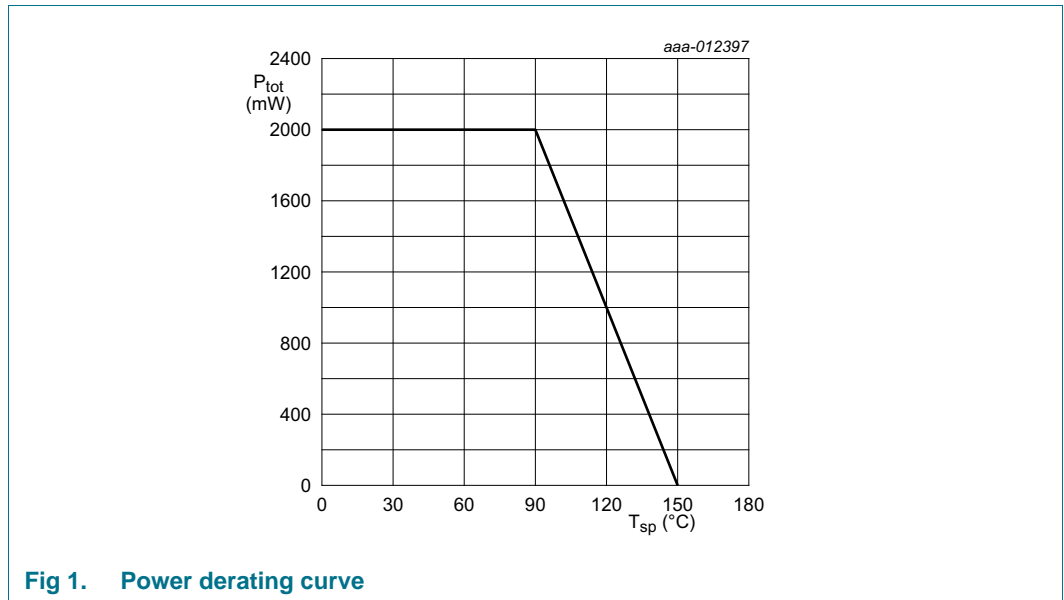


Fig 1. Power derating curve

9. Characteristics

Table 9. Characteristics

$T_{amb} = 25\text{ °C}$ unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------|-------------------------------------|---|-----|-----|-----|------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage | $I_C = 100\text{ nA}; I_E = 0\text{ mA}$ | 24 | - | - | V |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = 150\text{ nA}; I_B = 0\text{ mA}$ | 12 | - | - | V |
| I_C | collector current | | - | 80 | 200 | mA |
| I_{CBO} | collector-base cut-off current | $I_E = 0\text{ mA}; V_{CB} = 8\text{ V}$ | - | <1 | - | nA |
| h_{FE} | DC current gain | $I_C = 80\text{ mA}; V_{CE} = 8\text{ V}$ | 60 | 95 | 130 | |
| C_e | emitter capacitance | $V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$ | - | 3.9 | - | pF |
| C_{re} | feedback capacitance | $V_{CE} = 8\text{ V}; f = 1\text{ MHz}$ | - | 1.1 | - | pF |
| C_c | collector capacitance | $V_{CB} = 8\text{ V}; f = 1\text{ MHz}$ | - | 1.9 | - | pF |
| f_T | transition frequency | $I_C = 50\text{ mA}; V_{CE} = 8\text{ V}; f = 900\text{ MHz}$ | - | 8.5 | - | GHz |

Table 9. Characteristics ...continued
 $T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

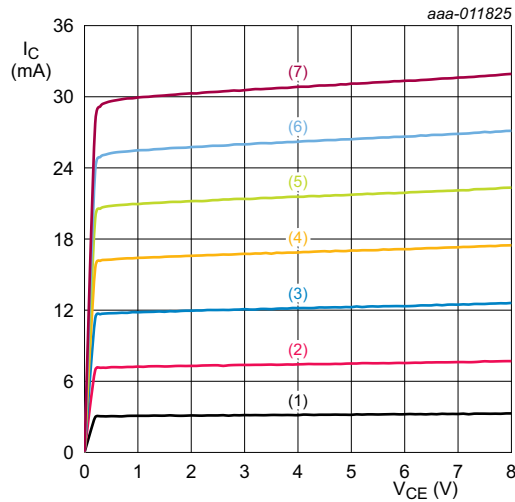
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|---------------------------------------|--|-----|------|-----|------|
| $G_{p(max)}$ | maximum power gain | $f = 433\text{ MHz}; V_{CE} = 8\text{ V}$ [1] | | | | |
| | | $I_C = 10\text{ mA}$ | - | 18.5 | - | dB |
| | | $I_C = 50\text{ mA}$ | - | 19.5 | - | dB |
| | | $I_C = 80\text{ mA}$ | - | 19.5 | - | dB |
| | | $f = 900\text{ MHz}; V_{CE} = 8\text{ V}$ [1] | | | | |
| | | $I_C = 10\text{ mA}$ | - | 13.5 | - | dB |
| | | $I_C = 50\text{ mA}$ | - | 13 | - | dB |
| | | $I_C = 80\text{ mA}$ | - | 13 | - | dB |
| | | $f = 1800\text{ MHz}; V_{CE} = 8\text{ V}$ [1] | | | | |
| | | $I_C = 10\text{ mA}$ | - | 8 | - | dB |
| | | $I_C = 50\text{ mA}$ | - | 8 | - | dB |
| | | $I_C = 80\text{ mA}$ | - | 8 | - | dB |
| $ S_{21} ^2$ | insertion power gain | $f = 433\text{ MHz}; V_{CE} = 8\text{ V}$ | | | | |
| | | $I_C = 10\text{ mA}$ | - | 16 | - | dB |
| | | $I_C = 50\text{ mA}$ | - | 17.5 | - | dB |
| | | $I_C = 80\text{ mA}$ | - | 17.5 | - | dB |
| | | $f = 900\text{ MHz}; V_{CE} = 8\text{ V}$ | | | | |
| | | $I_C = 10\text{ mA}$ | - | 10 | - | dB |
| | | $I_C = 50\text{ mA}$ | - | 11 | - | dB |
| | | $I_C = 80\text{ mA}$ | - | 11 | - | dB |
| | | $f = 1800\text{ MHz}; V_{CE} = 8\text{ V}$ | | | | |
| | | $I_C = 10\text{ mA}$ | - | 4.5 | - | dB |
| | | $I_C = 50\text{ mA}$ | - | 5.5 | - | dB |
| | | $I_C = 80\text{ mA}$ | - | 5.5 | - | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | $f = 433\text{ MHz}; V_{CE} = 8\text{ V}; Z_S = Z_L = 50\text{ }\Omega$ | | | | |
| | | $I_C = 50\text{ mA}$ | - | 20 | - | dBm |
| | | $I_C = 80\text{ mA}$ | - | 22.5 | - | dBm |
| | | $f = 900\text{ MHz}; V_{CE} = 8\text{ V}; Z_S = Z_L = 50\text{ }\Omega$ | | | | |
| | | $I_C = 50\text{ mA}$ | - | 19.5 | - | dBm |
| | | $I_C = 80\text{ mA}$ | - | 21.5 | - | dBm |
| | | $f = 1800\text{ MHz}; V_{CE} = 8\text{ V}; Z_S = Z_L = 50\text{ }\Omega$ | | | | |
| | | $I_C = 50\text{ mA}$ | - | 18.5 | - | dBm |
| | $I_C = 80\text{ mA}$ | - | 21 | - | dBm | |

Table 9. Characteristics ...continued
 $T_{amb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|------------------|------------------------------------|---|-----|------|-----|------|--|
| IP3 _o | output third-order intercept point | $f_1 = 433\text{ MHz}; f_2 = 434\text{ MHz}; V_{CE} = 8\text{ V}; Z_S = Z_L = 50\text{ }\Omega$ | | | | | |
| | | $I_C = 50\text{ mA}$ | - | 29.5 | - | dBm | |
| | | $I_C = 80\text{ mA}$ | - | 32 | - | dBm | |
| | | $f_1 = 900\text{ MHz}; f_2 = 901\text{ MHz}; V_{CE} = 8\text{ V}; Z_S = Z_L = 50\text{ }\Omega$ | | | | | |
| | | $I_C = 50\text{ mA}$ | - | 29 | - | dBm | |
| | | $I_C = 80\text{ mA}$ | - | 31 | - | dBm | |
| | | $f_1 = 1800\text{ MHz}; f_2 = 1801\text{ MHz}; V_{CE} = 8\text{ V}; Z_S = Z_L = 50\text{ }\Omega$ | | | | | |
| | | $I_C = 50\text{ mA}$ | - | 28 | - | dBm | |
| | | $I_C = 80\text{ mA}$ | - | 30.5 | - | dBm | |

[1] If $K > 1$ then $G_{p(max)}$ is the maximum power gain. If $K < 1$ then $G_{p(max)} = \text{MSG}$.

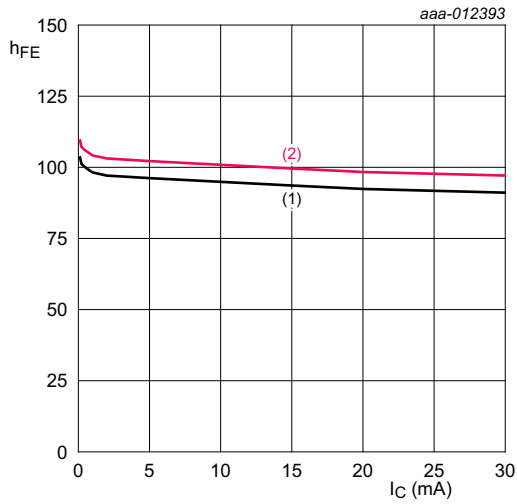
9.1 Graphs



$T_{amb} = 25\text{ }^{\circ}\text{C}$.

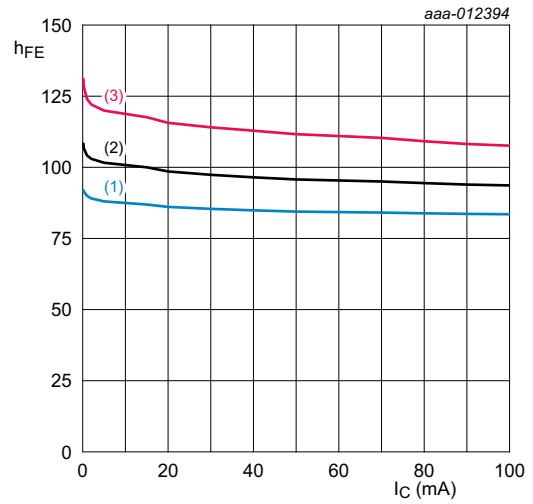
- (1) $I_B = 25\text{ }\mu\text{A}$
- (2) $I_B = 75\text{ }\mu\text{A}$
- (3) $I_B = 125\text{ }\mu\text{A}$
- (4) $I_B = 175\text{ }\mu\text{A}$
- (5) $I_B = 225\text{ }\mu\text{A}$
- (6) $I_B = 275\text{ }\mu\text{A}$
- (7) $I_B = 325\text{ }\mu\text{A}$

Fig 2. Collector current as a function of collector-emitter voltage; typical values



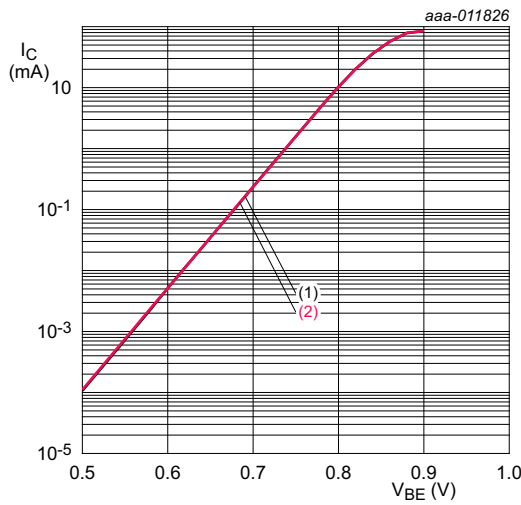
$T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $V_{CE} = 3.0\text{ V}$
 (2) $V_{CE} = 8.0\text{ V}$

Fig 3. DC current gain as a function of collector current; typical values



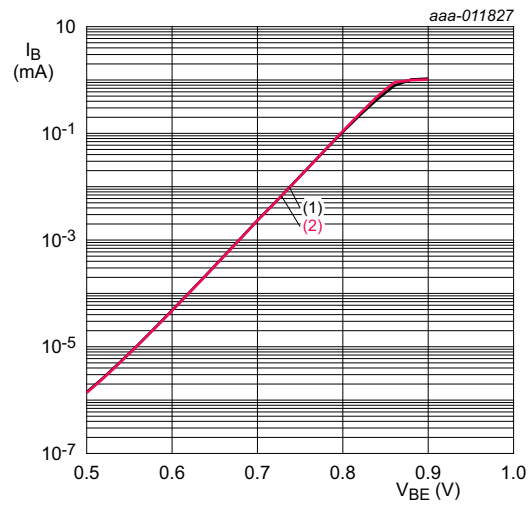
$V_{CE} = 8\text{ V}.$
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +125\text{ }^{\circ}\text{C}$

Fig 4. DC current gain as a function of collector current; typical values



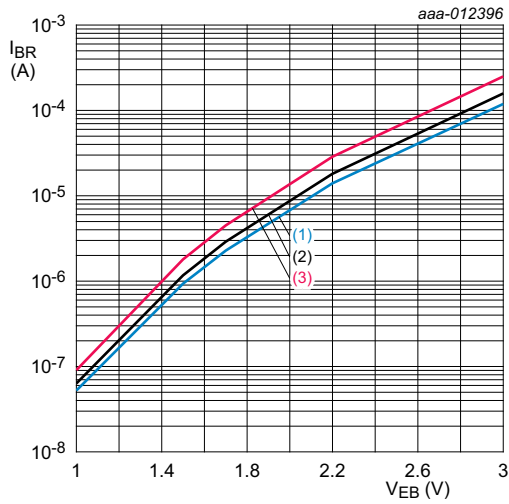
$T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $V_{CE} = 3.0\text{ V}$
 (2) $V_{CE} = 8.0\text{ V}$

Fig 5. Collector current as a function of base-emitter voltage; typical values



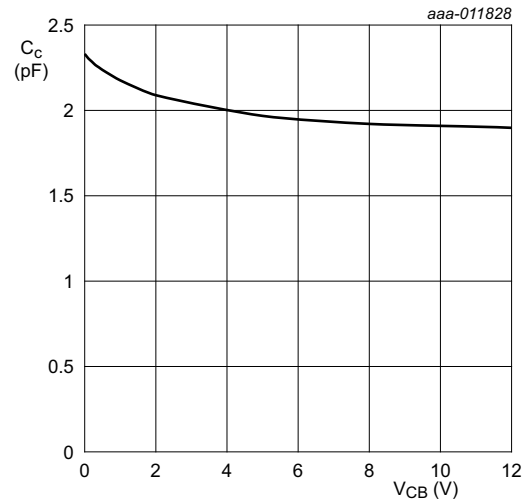
$T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $V_{CE} = 3.0\text{ V}$
 (2) $V_{CE} = 8.0\text{ V}$

Fig 6. Base current as a function of base-emitter voltage; typical values



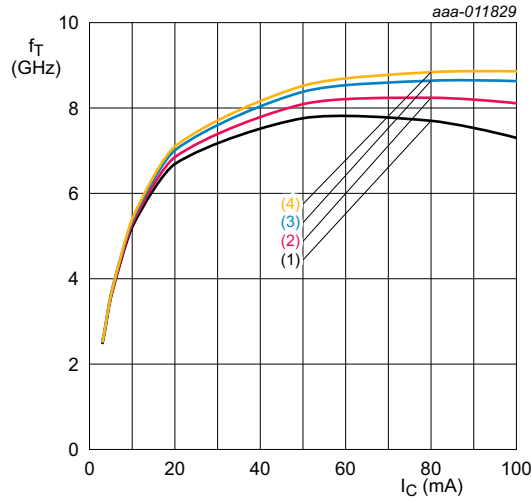
$V_{CE} = 3\text{ V}$.
 (1) $T_{amb} = -40\text{ }^{\circ}\text{C}$
 (2) $T_{amb} = +25\text{ }^{\circ}\text{C}$
 (3) $T_{amb} = +125\text{ }^{\circ}\text{C}$

Fig 7. Reverse base current as a function of emitter-base voltage; typical values



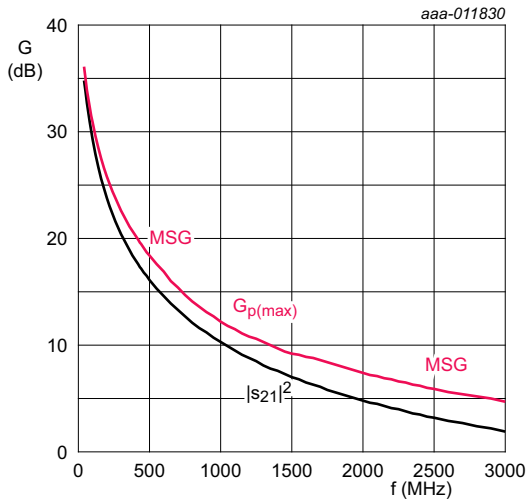
$I_C = 0\text{ mA}$; $f = 1\text{ MHz}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Fig 8. Collector capacitance as a function of collector-base voltage; typical values



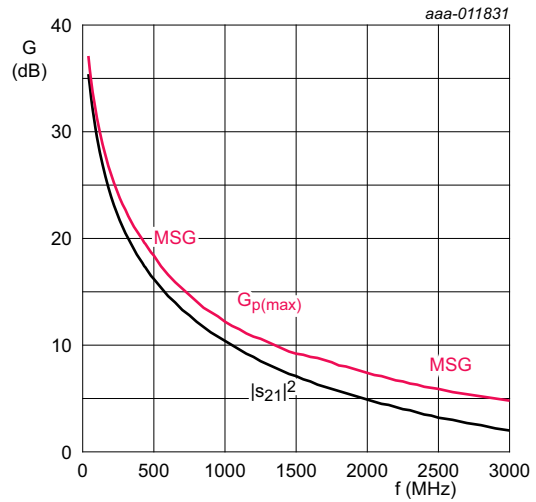
$T_{amb} = 25\text{ }^{\circ}\text{C}$.
 (1) $V_{CE} = 3.3\text{ V}$
 (2) $V_{CE} = 5.0\text{ V}$
 (3) $V_{CE} = 8.0\text{ V}$
 (4) $V_{CE} = 12.0\text{ V}$

Fig 9. Transition frequency as a function of collector current; typical values



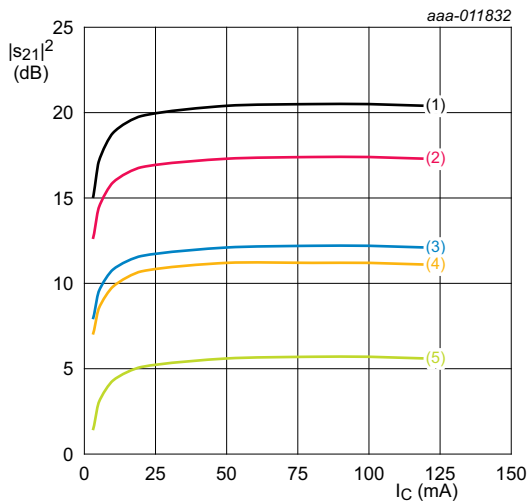
$I_C = 50 \text{ mA}; V_{CE} = 8 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}.$

Fig 10. Gain as a function of frequency; typical values



$I_C = 80 \text{ mA}; V_{CE} = 8 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}.$

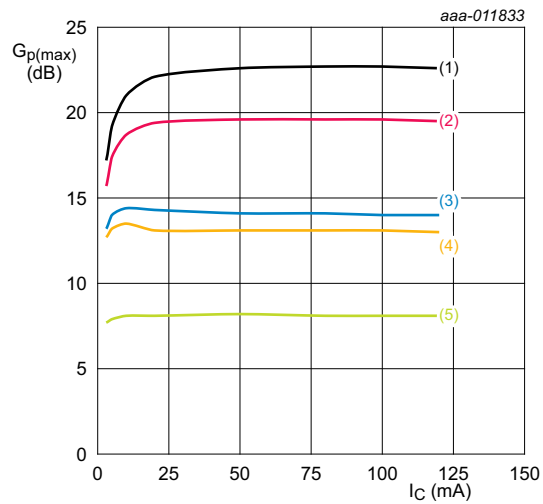
Fig 11. Gain as a function of frequency; typical values



$V_{CE} = 8 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}.$

- (1) $f = 300 \text{ MHz}$
- (2) $f = 433 \text{ MHz}$
- (3) $f = 800 \text{ MHz}$
- (4) $f = 900 \text{ MHz}$
- (5) $f = 1800 \text{ MHz}$

Fig 12. Insertion power gain as a function of collector current; typical values

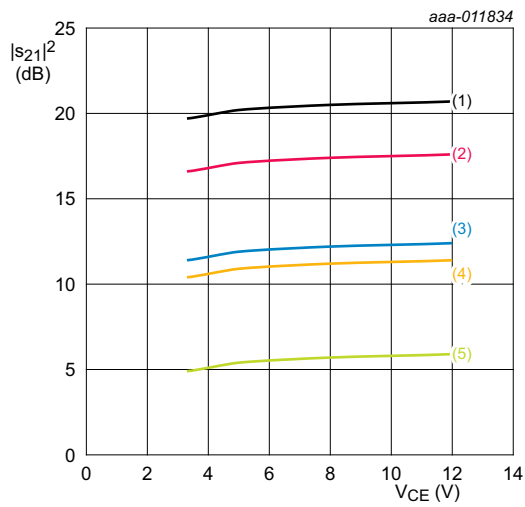


$V_{CE} = 8 \text{ V}; T_{amb} = 25 \text{ }^\circ\text{C}.$

If $K > 1$ then $G_{p(max)}$ = maximum power gain. If $K < 1$ then $G_{p(max)}$ = MSG.

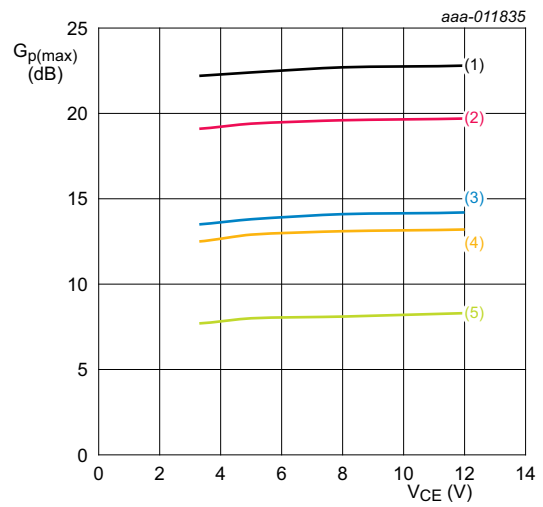
- (1) $f = 300 \text{ MHz}$
- (2) $f = 433 \text{ MHz}$
- (3) $f = 800 \text{ MHz}$
- (4) $f = 900 \text{ MHz}$
- (5) $f = 1800 \text{ MHz}$

Fig 13. Maximum power gain as a function of collector current; typical values



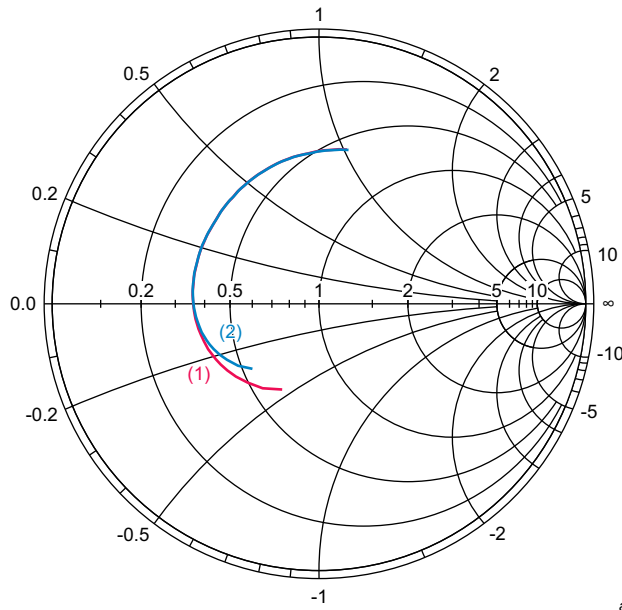
- $I_C = 50 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}.$
- (1) $f = 300 \text{ MHz}$
 - (2) $f = 433 \text{ MHz}$
 - (3) $f = 800 \text{ MHz}$
 - (4) $f = 900 \text{ MHz}$
 - (5) $f = 1800 \text{ MHz}$

Fig 14. Insertion power gain as a function of collector-emitter voltage; typical values



- $I_C = 80 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C}.$
- If $K > 1$ then $G_{p(max)}$ = maximum power gain. If $K < 1$ then $G_{p(max)}$ = MSG.
- (1) $f = 300 \text{ MHz}$
 - (2) $f = 433 \text{ MHz}$
 - (3) $f = 800 \text{ MHz}$
 - (4) $f = 900 \text{ MHz}$
 - (5) $f = 1800 \text{ MHz}$

Fig 15. Maximum power gain as a function of collector-emitter voltage; typical values

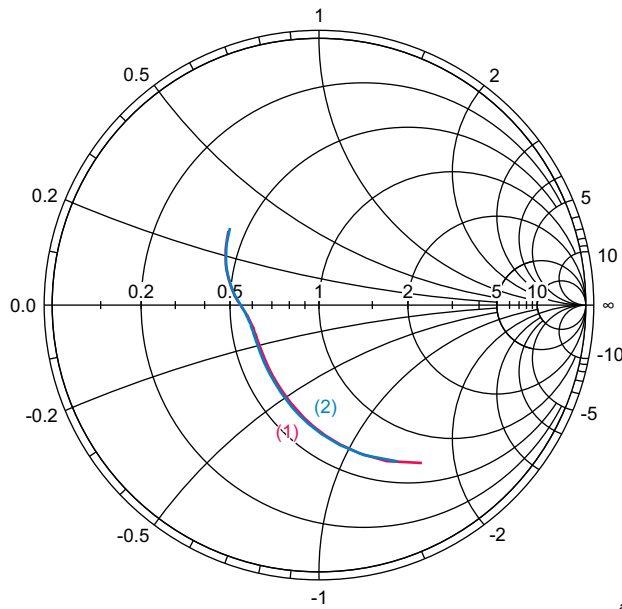


aaa-011836

$V_{CE} = 8\text{ V}; 40\text{ MHz} \leq f \leq 3\text{ GHz}.$

- (1) $I_C = 50\text{ mA}$
- (2) $I_C = 80\text{ mA}$

Fig 16. Input reflection coefficient (s_{11}); typical values

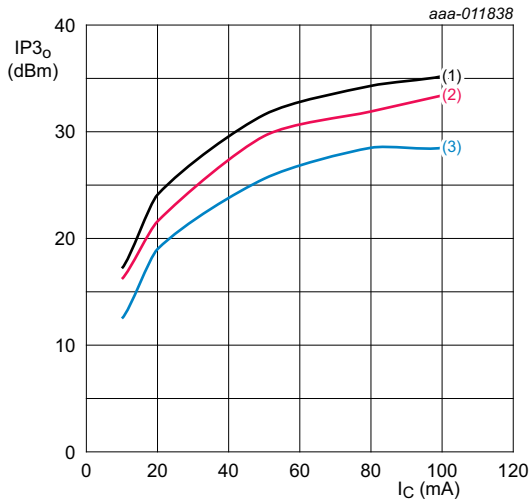


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$V_{CE} = 8\text{ V}; 40\text{ MHz} \leq f \leq 3\text{ GHz}.$

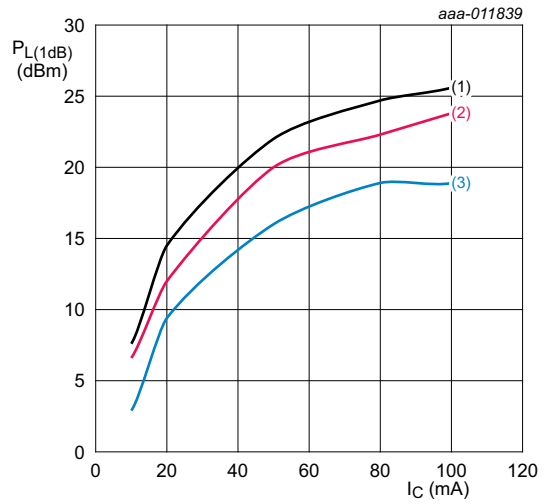
- (1) $I_C = 50\text{ mA}$
- (2) $I_C = 80\text{ mA}$

Fig 17. Output reflection coefficient (s_{22}); typical values



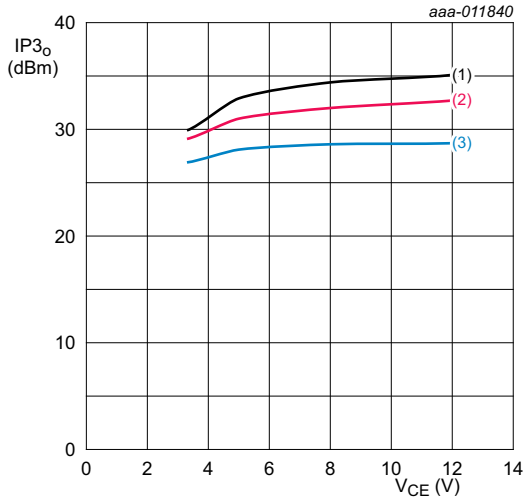
$V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $f_1 = 433\text{ MHz}; f_2 = 434\text{ MHz}$
 (2) $f_1 = 900\text{ MHz}; f_2 = 901\text{ MHz}$
 (3) $f_1 = 1800\text{ MHz}; f_2 = 1801\text{ MHz}$

Fig 18. Output third-order intercept point as a function of collector current; typical values



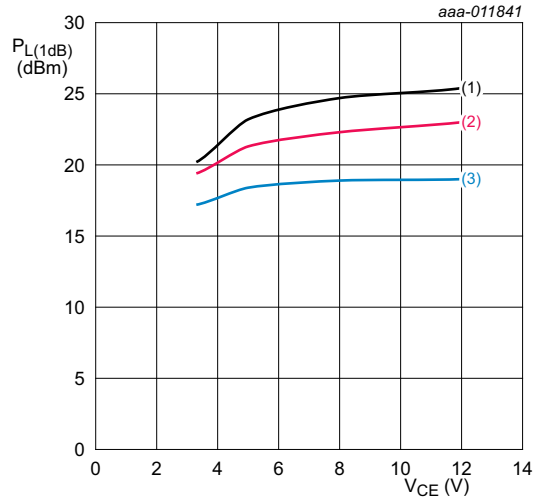
$V_{CE} = 8\text{ V}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $f = 433\text{ MHz}$
 (2) $f = 900\text{ MHz}$
 (3) $f = 1800\text{ MHz}$

Fig 19. Output power at 1 dB gain compression as a function of collector current; typical values



$I_C = 80\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $f_1 = 433\text{ MHz}; f_2 = 434\text{ MHz}$
 (2) $f_1 = 900\text{ MHz}; f_2 = 901\text{ MHz}$
 (3) $f_1 = 1800\text{ MHz}; f_2 = 1801\text{ MHz}$

Fig 20. Output third-order intercept point as a function of collector-emitter voltage; typical values



$I_C = 80\text{ mA}; T_{amb} = 25\text{ }^{\circ}\text{C}.$
 (1) $f = 433\text{ MHz}$
 (2) $f = 900\text{ MHz}$
 (3) $f = 1800\text{ MHz}$

Fig 21. Output power at 1 dB gain compression as a function of collector-emitter voltage; typical values

10. Application information

More information about the following application example can be found in the application notes. See [Section 5 “Design support”](#).

The following application example can be implemented using the evaluation kit. See [Section 3 “Ordering information”](#) for the order type number.

The following application example can be simulated using the simulation package. See [Section 5 “Design support”](#).

10.1 Application example: 433 MHz PA

More detailed information of the application example can be found in the application note: *AN11503*.

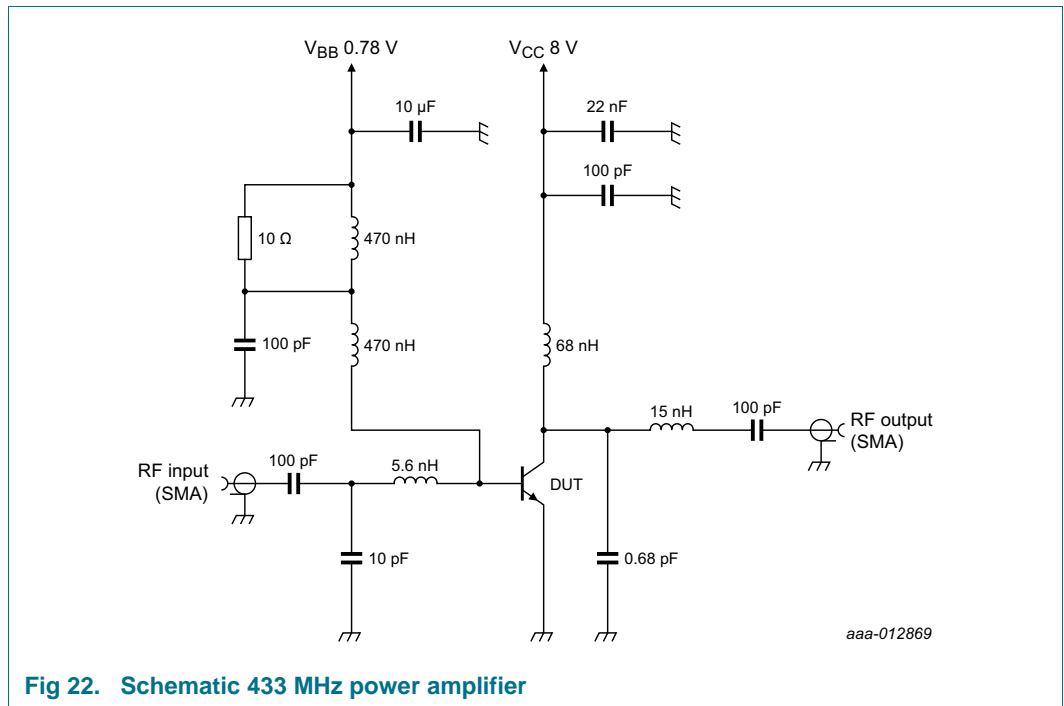


Fig 22. Schematic 433 MHz power amplifier

Remark: fine tuning of components maybe required depending on PCB parasitics.

Table 10. Application performance data at 433 MHz

$I_{CC} = 100 \text{ mA}$; $V_{CC} = 8 \text{ V}$

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|---------------------------------------|------------|-----|-----|-----|------|
| $ S_{21} ^2$ | insertion power gain | | - | 15 | - | dB |
| $ S_{11} ^2$ | input return loss | | - | -7 | - | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 26 | - | dBm |
| η_C | collector efficiency | | - | 60 | - | % |

10.2 Application example: 866 MHz PA

More detailed information of the application example can be found in the application note: AN11501.

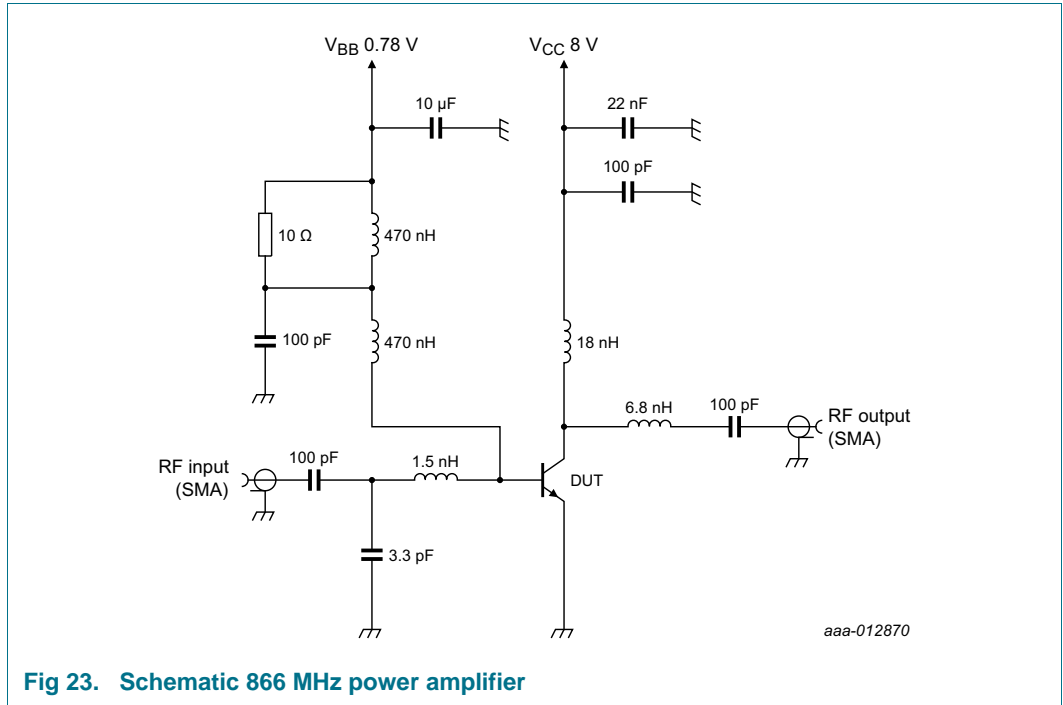


Fig 23. Schematic 866 MHz power amplifier

Remark: fine tuning of components may be required depending on PCB parasitics.

Table 11. Application performance data at 866 MHz

$I_{CC} = 100\text{ mA}$; $V_{CC} = 8\text{ V}$

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------|---------------------------------------|------------|-----|-----|-----|------|
| $ S_{21} ^2$ | insertion power gain | | - | 10 | - | dB |
| $ S_{11} ^2$ | input return loss | | - | -12 | - | dB |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 27 | - | dBm |
| η_C | collector efficiency | | - | 55 | - | % |

11. Package outline

Plastic surface-mounted package with increased heatsink; 4 leads

SOT223

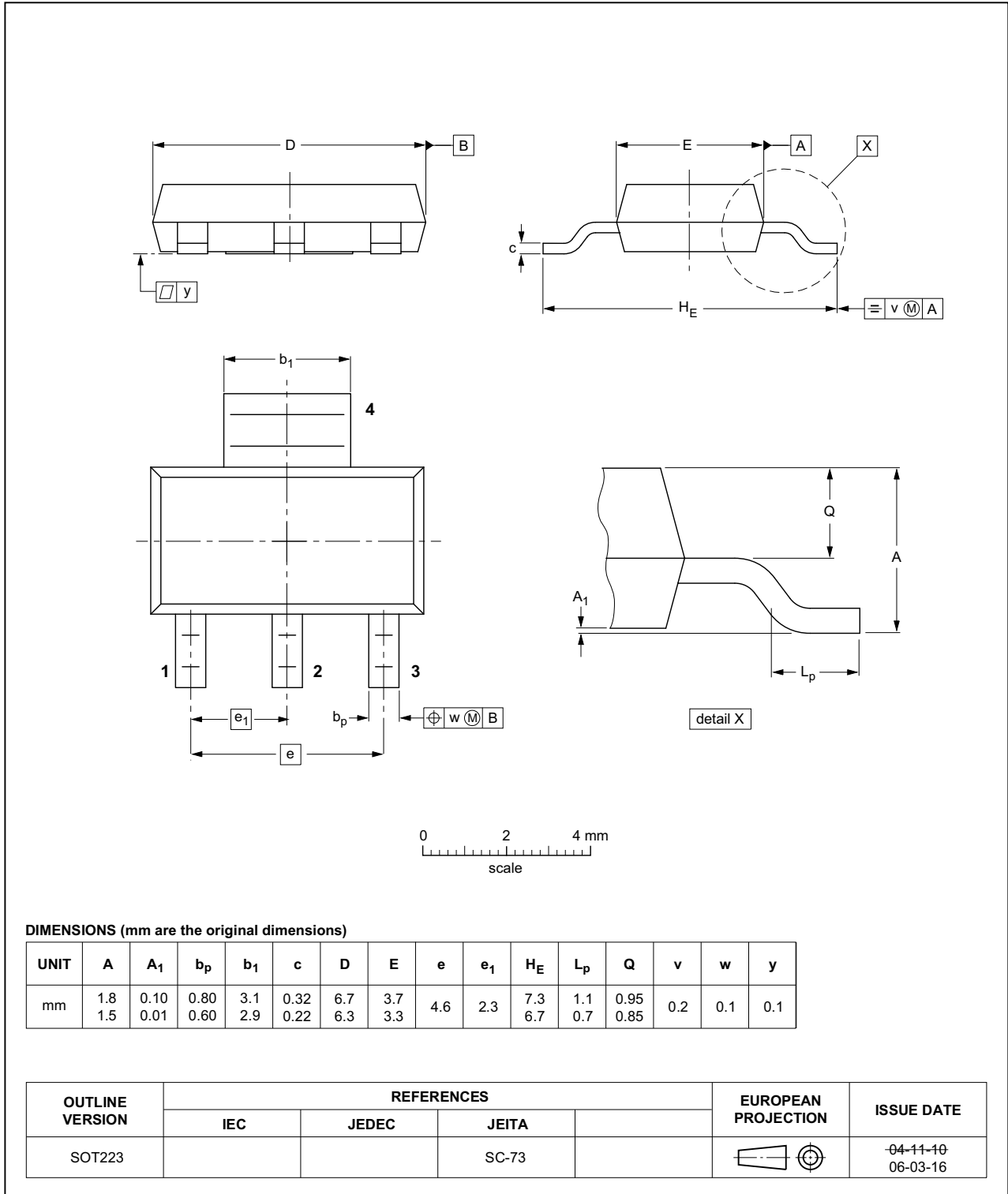


Fig 24. Package outline SOT223

12. Handling information

CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

13. Abbreviations

Table 12. Abbreviations

| Acronym | Description |
|---------|------------------------------------|
| AEC | Automotive Electronics Council |
| ISM | Industrial, Scientific and Medical |
| LNA | Low-Noise Amplifier |
| MSG | Maximum Stable Gain |
| NPN | Negative-Positive-Negative |
| PA | Power Amplifier |
| SMA | SubMiniature version A |

14. Revision history

Table 13. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-------------|--------------|--------------------|---------------|------------|
| BFU590G v.1 | 20140428 | Product data sheet | - | - |

15. Legal information

15.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
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[1] Please consult the most recently issued document before initiating or completing a design.

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